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# IMMUNITY OF PIGMENTED PLANTS AND ANTIBIOTICS

A. F. Kapustinskiy
Leningrad

/A Digest./

The higher resistance of pigmented plants to diseases, as compared with nonpigmented varieties, has already been noticed by C. Darwin. It has been commented upon by many investigators. The immunity of colored varieties of onion to various diseases which affect the colorless varieties has been established (Tokin, 1942). Under the circumstances one must bear in mind that plants which appear colorless to the eye are nevertheless pigmented in the sense that ultraviolet light may be selectively absorbed by a colorless anthocyan isomer.

Bread cereals form a notable exception to the behavior of plants as far as the increased immunity of pigmented varieties having a high anthocyan content is concerned: this relationship does not hold here in regard to the susceptibility exhibited toward several fungus infections.

Plants react to fungus infections, damage done by insects, and other biological irritations by an increased production of anthocyans, i.e., colored spots are formed.

Blagoveshchenskiy (1945) studied the biological interdependence between the action of enzymes of the grape leaf and that of the enzymes introduced by phylloxera. He found that penetration of oxygen at the site of the prick brings about oxydation of flavones to quinones with subsequent formation of a red spot. It is interesting to note in this connection that varieties of grapes which are resistant to fungi are also resistant to phylloxera. Both conditions are apparently related to the formation of quinones and the presence of phenols (i.e., flavones which are structurally related to phenols) that can be oxidized to quinones. With a rising $p_H$, the toxicity of phenol derivatives to microorganisms



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rises, because oxidation of phenols to quinones is stimulated (Rubin and Artsikhovskaya, 1948).

A considerable number of recently discovered antibiotics has a quinone structure and contains a benzene nucleus (as for instance fumigation or citrinin); in other words, these antibiotics are closely related to flavones.

The correlation between phenol content and the resistance to rust was demonstrated by Anderson (1932) in the case of the wheat Khapli (Tr. dicoccum). He isolated from the leaves of that particular variety the flavone tricin. The same correlation was established by Kargopolova (1935) in varieties of Tr. Timopheevi which lie between Tr. dicoccum and Tr. spontaneum and exhibit a sharp reaction for protocathechuic acid in the ether extract.

Quite recently workers at Professor Gause's laboratory (Malaria Institute of the Academy of Medical Sciences USSR) isolated from the culture of a ray fungus found in soil (a blue proactinomycete) a specific pigment named litmocydin. This pigment turns red in acidic solution and blue in an alkaline solution. It has bactericidal properties and resembles very closely the pigments of the rose and violet, as far as its chemical properties are concerned (although litmocydin gives all the qualitative reaction of an anthocyanidin, it is not combined with a carbohydrate). Another example is furnished by Actinomyces violaceus. The pigment of this fungus is a typical anthocyan (Kriss, 1936). According to Krasil'nikov's data (1939), Actinomyces violaceus shows a pronounced antibacterial effect, particularly as far as pathogenic staphylococci are concerned. The active antibacterial principle named mycetin has been isolated from it.

The facts outlined above clearly suggest a parallelism between the biochemical properties of anthocyans (flavones) derived from higher plants and those of antibiotics formed by fungi and isolated from them. The apparent similarity between anthocyanins and antibiotics induced us to investigate the activity of the anthocyanins of poppy in that respect. There is a considerable variety of poppy anthocyanins. Some varieties of poppies are resistant to infection, while others are not. We have tested the action of the flower juice of resistant varieties on Micrococcus luteus and Mycobacterium citreum. We found a positive bacteriostatic effect in the case of Mycobacterium citreum with a 10-millimeter-wide zone of bacteriostatic action (temporary stoppage of growth). There was a complete bactericidal effect in the case of Micrococcus luteus with a permanent stoppage of growth in a zone 10 millimeters wide and bacteriostatic action in a zone 15 millimeters wide.

Apparently flower juice containing an anthocyan acts on microorganisms which are pathogenic to humans just as it does on fungi infesting the plant. The recently discovered antibiotic tomatin, which occurs in tomatoes resistant to infection, is another example of this parallelism of action.

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